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April 17, 2019

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: Notice of *Ex Parte* Presentation, IB Docket No. 11-109; IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, and SAT-MOD-20151231-00091

Dear Ms. Dortch:

On April 15, 2019, Valerie Green, Executive Vice President and Chief Legal Officer of Ligado Networks LLC ("Ligado"), and the undersigned met with Umair Javed, Legal Advisor to Commissioner Rosenworcel. The parties discussed the attached presentation which highlights the critical importance of lower mid-band spectrum such as Ligado's to the future of 5G, and how the 1675-1680 MHz band is part of this spectrum proposal. The parties also discussed how well over 1,000 days have passed since Ligado submitted its license modification applications. Finally, the parties discussed how the record before the Commission regarding Ligado's pending license modification applications is complete and how the Commission therefore should proceed in approving Ligado's applications.

Please direct any questions to the undersigned.

Sincerely,

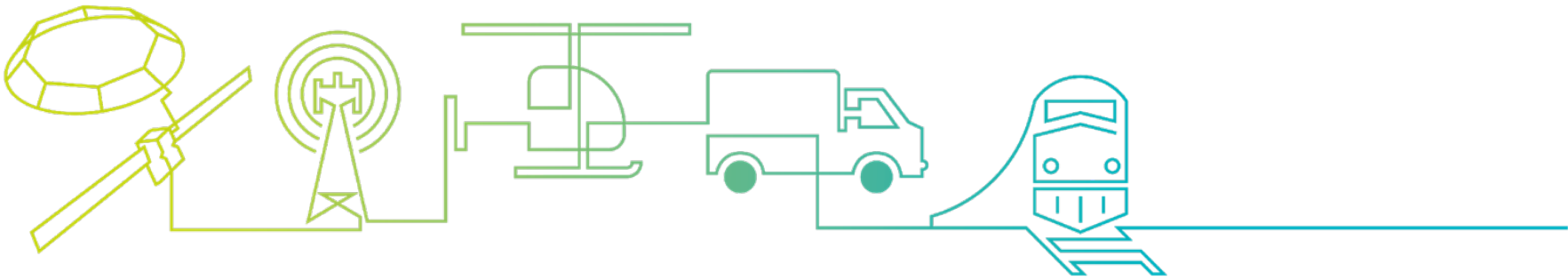
/s/
Gerard J. Waldron
Counsel to Ligado Networks LLC

Attachment

cc: Mr. Javed

Ligado Networks: Facilitating a 5G Future with Mid-Band Spectrum

APRIL 15, 2019



ligado NETWORKS | Making Stronger Connections

Discussion Overview

- 5G and Ligado Networks' Mid-Band Spectrum
- Lower Mid-Band Spectrum Plays a Critical and Complementary Role in 5G
- Ligado Has Resolved All Concerns Raised in the Record
- 1675-1680 MHz Can be Shared and NOAA's Operations Fully Protected

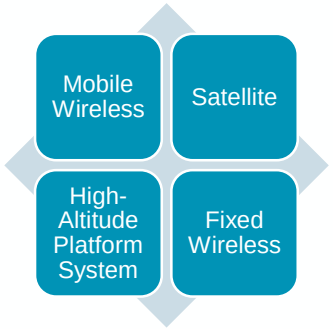
5G and Ligado's Mid-Band Spectrum

5G Vision

5G refers to a set of requirements and use cases:

- Enhanced Mobile Broadband (eMBB)
  - *High data rates, spectral efficiency, high traffic density*
- Massive Machine Type Communications (mMTC)
  - *High connection density*
- Ultra-Reliable Low Latency Communications (URLLC)
  - *Super low latency, 99.999% reliability*

Heterogeneity of needs requires a "network of networks" and more available spectrum in every band category



Band Categories
Low Band (<1 GHz)
Lower Mid-Band (1-2 GHz)
Higher Mid-Band (2-6 GHz)
High Band (mmWave)

Global push by carriers, infrastructure providers, technology companies, standards bodies, regulators, and most importantly countries to be leaders in 5G

Ligado's Role in 5G Vision

Greenfield Spectrum

40 MHz of flexible licensed spectrum in the lower mid-band that can enable faster and more efficient deployment of 5G networks

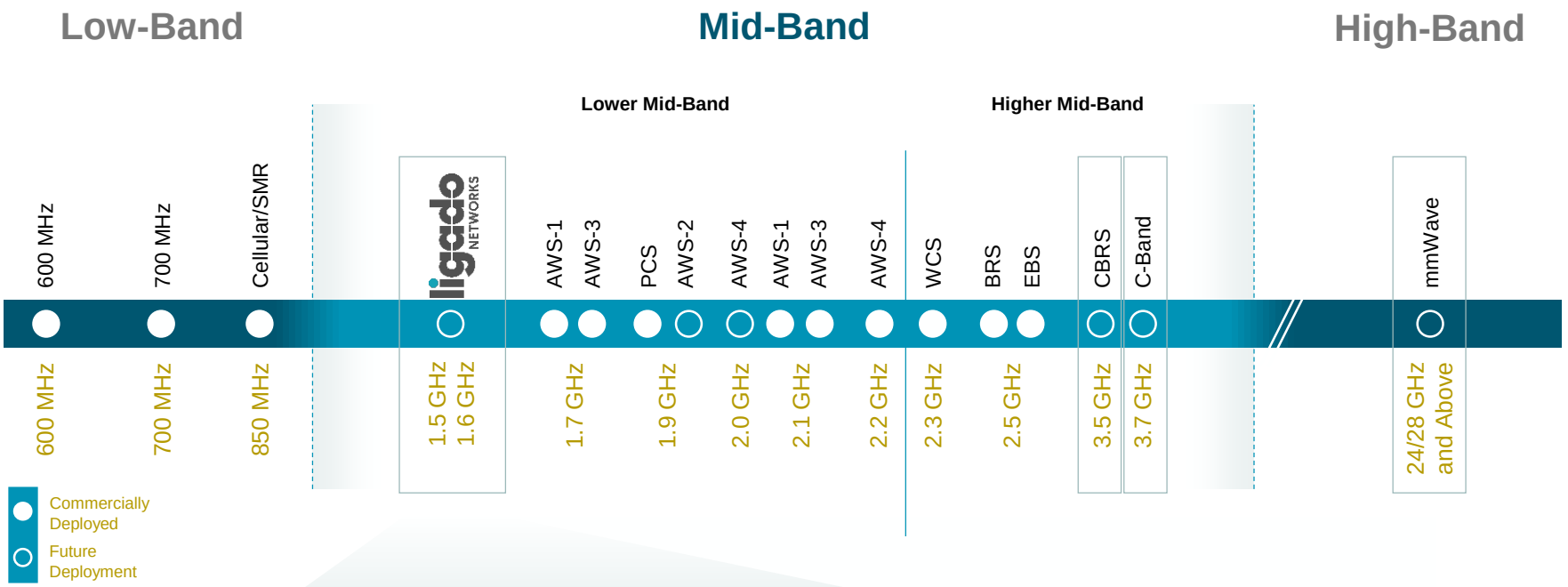
Satellite

State-of-the-art satellite that provides coverage throughout North America, delivers connectivity to small form factor devices, and will support network redundancy/remote coverage for IoT

Technology / Ecosystem

Development in process with leading technology vendors for base stations, deployment analysis, band standardization / commercialization, and standards-based technology for satellite IoT

L-Band is Among the Key Spectrum Bands in the Near Term Pipeline



KEY L-BAND FEATURES

Optimal Balance of Coverage and Capacity	Rapid and Easy Ecosystem Adoption	Globally Coordinated

Ligado's plan can deliver 40 MHz of lower mid-band spectrum

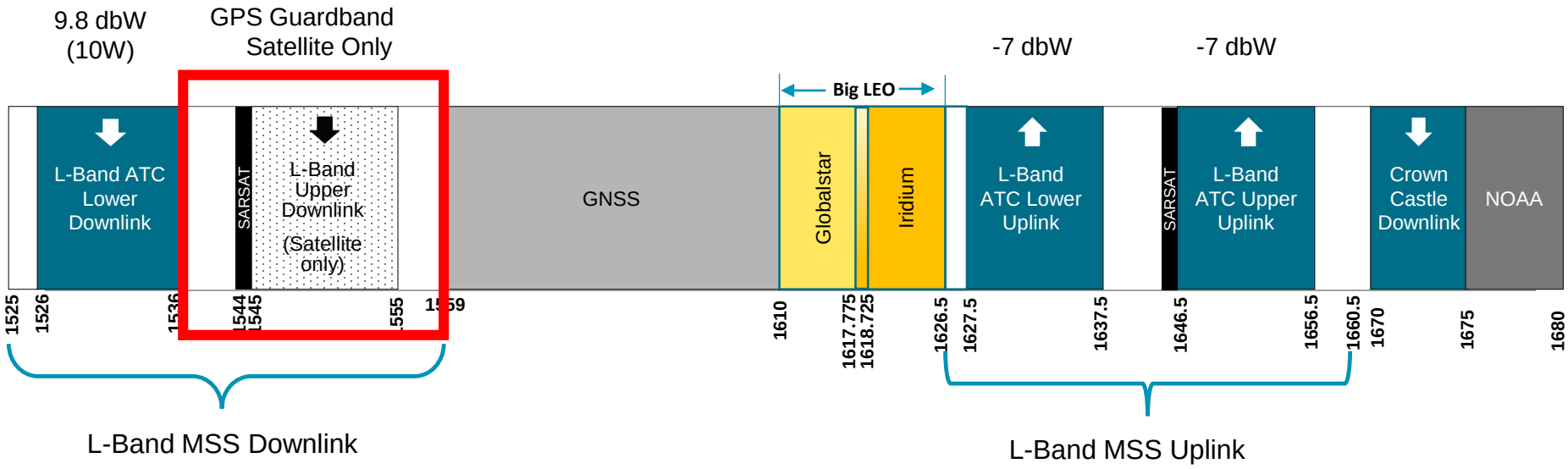
Lower Mid-Band Spectrum Plays a Critical and Complementary Role in 5G

		Low-Band (< 1 GHz)	Lower Mid-Band (1 – 2 GHz)	Higher Mid-Band (2 – 6 GHz)	High-Band (mmWave)
Spectrum Flexibility and Usability	Macro	●	●	◑	○
	Micro	●	●	●	○
	Small / Indoor	○	●	●	●
	Broad-Based Mobility	●	●	◑	○
	In-Building Penetration	Effective	Effective	Limited	None
Global Spectrum Availability		**600 MHz**	**None**	**CBRS, C-Band**	**24 GHz, 28 GHz, 37 GHz, 47 GHz**
		**700 MHz**	**1.4 - 1.5 GHz***	**3.4 - 3.8 GHz**	**24.5 - 27.5 GHz**
		**None**	**1.4 - 1.5 GHz***	**3.3 - 3.6 GHz, 4.8 - 5.0 GHz**	**24.5 - 27.5 GHz 37.5 - 42.5 GHz**

*1427-1518 MHz was allocated/identified in World Radio Conference 2015 for mobile services in all ITU regions and countries except US

Because not all spectrum is the same, a heterogenous spectrum portfolio is needed to fulfil the heterogenous needs of 5G

Ligado's Current L-Band Plan



Current Spectrum Plan Protects GPS:

- 23 MHz guardband created for GPS; Ligado agreed to use 1545-1555 MHz for satellite only
- Lower power in all channels; improved OOBEs
- Certified aviation devices (safety of life) protected by power level of 9.8 dBW (10W) in the lower downlink as requested by FAA and DOT

Chart not to scale.

Ligado Has Resolved All Concerns Raised in the Record

Government Use of GPS	• Ligado has committed to mitigate any impact on U.S. government GPS devices, including the repair or replacement of such devices as necessary, both pre- and post-deployment.
Commercial Use of GPS	• Co-existence agreements with the five major GPS device manufacturers, thousands of hours of testing at NASCTN, and Ligado's adoption of the power level recommended in the DOT Report confirm and ensure that Ligado's proposed terrestrial operations will not cause harmful interference to commercial GPS devices.
Complaints Raised by Iridium	• DOD-sponsored analysis by Alion concluded that Ligado's proposed terrestrial operations will not cause harmful interference to Iridium's operations by government and commercial users. • Ligado analysis in the record shows the same thing.
Commercial Use of SATCOM	• Inmarsat is developing a commercial and technical plan to address any potentially necessary retrofitting; all aviation stakeholders are involved in the development and approval of this new technology.

The NTIA Roadmap Seven Years Later: GPS is Protected as NTIA Anticipated in 2012

2012 NTIA Proposal	Action Taken	Status
Modify operating parameters to reduce impacts on GPS receivers to an acceptable level	• Ligado modified its operating parameters to satisfy GPS industry that co-existence would not harm GPS	✓
GPS receivers used in cellular and personal/general navigation GPS receivers can be designed to be compatible with the lower 10 MHz base station signal and deployed *over time* without disrupting user requirements.	• Ligado worked directly with GPS companies to ensure receiver co-existence with Ligado's network • Resilient receivers are available in the market today	✓
NTIA to request FAA update standards	• Ligado worked with the FAA to develop a plan to protect all certified aviation devices; Ligado's proposal protects safety of life applications	✓
NTIA to lead review of receiver requirements	• Ligado worked directly with GPS companies to ensure receiver co-existence with Ligado's network	✓
NTIA to urge FCC to *mitigate GPS receiver impact on full spectrum utilization*	• Ligado worked directly with GPS companies to ensure receiver co-existence with Ligado's network	✓
PNT EXCOM to develop and establish new GPS interference standards that *strike a balance* between interference caused by transmitters and the performance of GPS receivers	• Ligado worked directly with GPS companies to ensure receiver co-existence with Ligado's network • All testing shows that the overwhelming majority of non-certified GPS devices will co-exist with Ligado's network, and the remaining devices can economically be modified or replaced	✓

1675-1680 MHz Can be Shared and NOAA's Operations Fully Protected

- The 1675-1680 MHz band can be unlocked for wireless broadband while at the same time ensuring that neither NOAA nor any other entity that accesses NOAA's weather data suffers harm.
  - The spectrum was first identified for auction in the FY 2014 President's Budget.
  - The FY 2020 Budget calls for the auction of the spectrum at a value of $600 million.
- NOAA's use is protected:
  - A study by Alion Science and Technology, an independent consulting firm selected in consultation with NOAA, demonstrates that NOAA's operations in the 1675-1680 MHz band can be protected through the establishment of geographic protection zones.
  - Ligado's proposed use of the band would respect these protection zones.
- Use by non-NOAA entities is protected:
  - To resolve any potential impact to the small number of non-NOAA users of data transmitted in this band, Ligado proposes that the Commission require the new commercial licensee of 1675-1680 MHz to provide the NOAA data via a cloud- and fiber-based content delivery network (CDN) using "push" technology.
  - Ligado has purchased a NOAA-compatible satellite receiver and dish system similar to those used by all non-NOAA users and developed a CDN, using an established cloud service provider, to deliver NOAA's weather data through the cloud and via fiber optic links.
  - After over a year operating the system, Ligado can report that the CDN is running according to the August 2016 plan and is delivering to George Mason University and the University of Oklahoma the same data NOAA currently provides in a timely and highly reliable manner.

Study Shows that NOAA's Earth Stations Can Be Protected

(Protection zones indicated are based on NOAA operations as of July 2019)

Summary

- 5G requires an "all of the above" spectrum strategy – increased spectrum availability in all four band categories (Low, Lower Mid-Band, Higher Mid-Band, and High)
- Many other nations have identified new spectrum for mobile services in lower mid-band, higher mid-band, and mmWave, but the 1427-1518 MHz band (lower mid-band) is not available in the U.S.
- Countries that have both lower and higher mid-band spectrum will secure a significant advantage in the speed and cost of deployment as 5G networks are rolled out
- Ligado has resolved concerns from the GPS industry and other stakeholders as well as concerns related to use of the 1675-1680 MHz band
- The Ligado 40 MHz opportunity is in the globally coordinated L-Band and fills an important spectrum gap that would otherwise hinder the U.S. in the global race to 5G